WHAT IS CLAIMED IS:

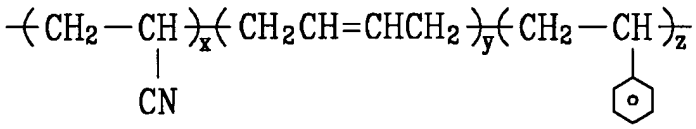
1. A binder for a lithium-sulfur battery, comprising:

a butadiene-based copolymer.

2. The binder of claim 1, wherein the butadiene-based copolymer is selected from the group consisting of an acrylonitrile-butadiene-styrene copolymer, an acrylonitrile-butadiene copolymer, and a modified styrene-butadiene copolymer.

3. The binder of claim 2, wherein the butadiene-based copolymer is selected from the group consisting of an acrylonitrile-butadiene-styrene rubber, an acrylonitrile-butadiene rubber, and a modified styrene-butadiene rubber.

4. The binder of claim 1, wherein the butadiene-based copolymer is represented by Formula 1:



(1)

and wherein:

when x is 0, y ranges from about 5 to about 40, and z ranges from about 60 to about 95;

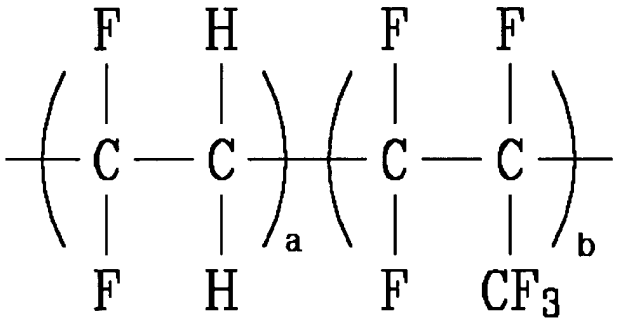
when z is 0, x ranges from about 60 to about 95 and y ranges from about 5 to about 40; and

when x, y, and z do not equal 0, x ranges from about 20 to about 75, y ranges from about 5 to about 20, and z ranges from about 20 to about 75.

5. The binder of claim 1, wherein the butadiene-based copolymer is a non-aqueous material.

6. The binder of claim 1, further comprising a fluorine-based polymer.

7. The binder of claim 6, wherein the fluorine-based polymer is represented by Formula 2:



(2)

and wherein a ranges from about 0.5 to about 1.0, and b ranges from about 0 to about 0.5.

8. The binder of claim 6, wherein the fluorine-based polymer is selected from the group consisting of a homopolymer prepared from monomers selected from the group consisting of C_2F_3Cl, C_2H_3F and $CH_3(CF_3C_2H_4)SiO$, and a copolymer including a first monomer and a second monomer, wherein the first monomer is selected from the group consisting of C_2F_4, C_2F_3Cl, CH_2CF_2, C_2H_3F and $CH_3(CF_3C_2H_4)SiO$, and the second monomer is selected from the group consisting of C_2H_4, C_3H_6, CH_2=CHOR where R is a C_1 to C_{20} alkyl group, C_3F_6 and CF_2=CFORf where Rf is a C_1 to C_{20} alkyl group with at least one fluorine atom.

9. A positive active material composition for a lithium-sulfur battery, comprising:

a positive active material comprising sulfur or a sulfur-based compound;

a conductive agent;

an organic solvent;

a binder comprising a butadiene-based copolymer, wherein the binder is distributed in the organic solvent to form an emulsion with particle sizes of 15 micrometers or less; and

an agent for controlling viscosity.

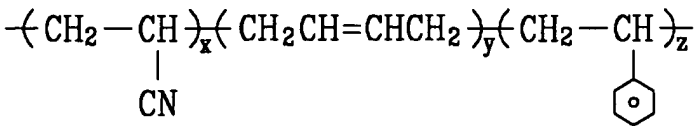
10. The positive active material composition of claim 9, wherein the binder is presented in the amount of 2 to 6% by weight of the positive active material composition.

11. The positive active material composition of claim 10, wherein the binder is presented in the amount of 2 to 3% by weight of the positive active material composition.

12. The positive active material composition of claim 9, wherein the butadiene-based copolymer is selected from the group consisting of an acrylonitrile-butadiene-styrene copolymer, an acrylonitrile-butadiene copolymer, and a modified styrene-butadiene copolymer.

13. The positive active material composition of claim 12, wherein the butadiene-based copolymer is selected from the group consisting of an acrylonitrile-butadiene-styrene rubber, an acrylonitrile-butadiene rubber, and a modified styrene-butadiene rubber.

14. The positive active material composition of claim 9, wherein the butadiene-based copolymer is represented by Formula 1:



(1)

and wherein:

when x is 0, y ranges from about 5 to about 40, and z ranges from about 60 to about 95;

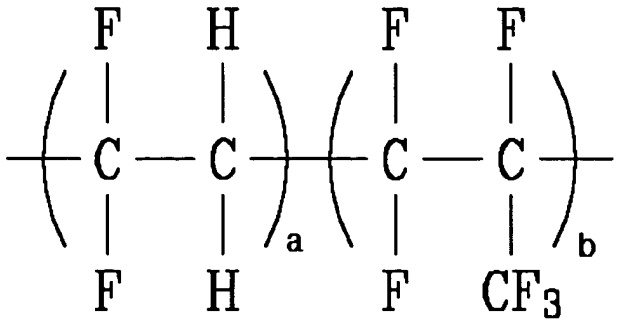
when z is 0, x ranges from about 60 to about 95 and y ranges from about 5 to about 40; and

when x, y, and z do not equal 0, x ranges from about 20 to about 75, y ranges from about 5 to about 20, and z ranges from about 20 to about 75.

15. The positive active material composition of claim 9, wherein the butadiene-based copolymer is non-aqueous.

16. The positive active material composition of claim 9, further comprising a fluorine-based polymer.

17. The positive active material composition of claim 16, wherein the fluorine-based polymer is represented by Formula 2:



(2)

and wherein a ranges from about 0.5 to about 1.0, and b ranges from about 0 to about 0.5.

18. The positive active material composition of claim 16, wherein the fluorine-based polymer is selected from the group consisting of a homopolymer prepared from monomers selected from the group consisting of C_2F_3Cl, C_2H_3F and $CH_3(CF_3C_2H_4)SiO$, and a copolymer including a first monomer and a second monomer, wherein the first monomer is selected from the group consisting of C_2F_4, C_2F_3Cl, CH_2CF_2, C_2H_3F and $CH_3(CF_3C_2H_4)SiO$, and the second monomer is selected from the group consisting of C_2H_4, C_3H_6, CH_2=CHOR where R is a C_1 to C_{20} alkyl group, C_3F_6 and CF_2=CFORf where Rf is a C_1 to C_{20} alkyl group with at least one fluorine atom.

19. The positive active material composition of claim 9, wherein the agent for controlling viscosity is selected from the group consisting of a cellulose-based polymer, polyvinyl alcohol, polyvinylpyrrolidone, polyacrylic acid, polyacrylamide, polyethyleneoxide, and polyethyleneimine.

20. The positive active material composition of claim 19, wherein the cellulose-based polymer is selected from the group consisting of methyl cellulose, hydroxypropyl methylcellulose, hydroxyethyl-cellulose, or carboxymethyl cellulose.

21. A lithium-sulfur battery, comprising:

a positive electrode comprising a positive active material, a conductive agent, and a binder comprising a butadiene-based copolymer;

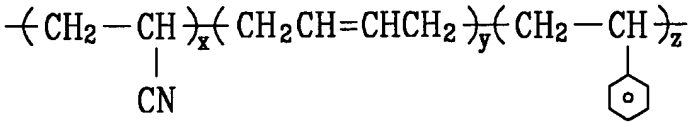
a negative electrode; and

an electrolyte.

22. The lithium-sulfur battery of claim 21, wherein the butadiene-based copolymer is selected from the group consisting of an acrylonitrile-butadiene-styrene copolymer, an acrylonitrile-butadiene copolymer, and a modified styrene-butadiene copolymer.

23. The lithium-sulfur battery of claim 22, wherein the butadiene-based copolymer is selected from the group consisting of an acrylonitrile-butadiene-styrene rubber, an acrylonitrile-butadiene rubber, and a modified styrene-butadiene rubber.

24. The lithium-sulfur battery of claim 21, wherein the butadiene-based copolymer is represented by Formula 1:



(1)

and wherein:

when x is 0, y ranges from about 5 to about 40, and z ranges from about 60 to about 95;

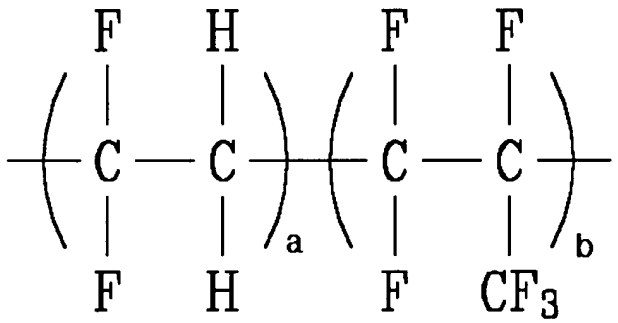
when z is 0, x ranges from about 60 to about 95 and y ranges from about 5 to about 40; and

when x, y, and z do not equal 0, x ranges from about 20 to about 75, y ranges from about 5 to about 20, and z ranges from about 20 to about 75.

25. The lithium-sulfur battery of claim 21, wherein the butadiene-based copolymer is non-aqueous.

26. The lithium-sulfur battery of claim 21, further comprising a fluorine-based polymer.

27. The lithium-sulfur battery of claim 26, wherein the fluorine-based polymer is represented by Formula 2:



(2)

and wherein a ranges from about 0.5 to about 1.0, and b ranges from about 0 to about 0.5.

28. The lithium-sulfur battery of claim 26, wherein the fluorine-based polymer is selected from the group consisting of a homopolymer prepared from monomers selected from the group consisting of C_2F_3Cl, C_2H_3F and $CH_3(CF_3C_2H_4)SiO$, and a copolymer including a first monomer and a second monomer, wherein the first monomer is selected from the group consisting of C_2F_4, C_2F_3Cl, CH_2CF_2, C_2H_3F and $CH_3(CF_3C_2H_4)SiO$, and the second monomer is selected from the group consisting of C_2H_4, C_3H_6, CH_2=CHOR where R is a C_1 to C_{20} alkyl group, C_3F_6 and CF_2=CFORf where Rf is a C_1 to C_{20} alkyl group with at least one fluorine atom.

29. The lithium-sulfur battery of claim 21, wherein the agent for controlling viscosity is selected from the group consisting of a cellulose-based polymer, polyvinyl alcohol, polyvinylpyrrolidone, polyacrylic acid, polyacrylamide, polyethyleneoxide, and polyethyleneimine.

30. The lithium-sulfur battery of claim 29, wherein the cellulose-based polymer is selected from the group consisting of methyl cellulose, hydroxypropyl methylcellulose, hydroxycthyl-cellulose, or carboxymethyl cellulose.